PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION
No. 6602 A.D. 1943.

Improvements in or relating to Valves and Cocks

I, CHARLES GUTHRIE GUTHRIE, a British Subject, of "Altair", Formby, in the County of Lancaster, do hereby declare the nature of this invention to be as follows:—

This invention is for improvements in or relating to valves and cocks.

In the aforementioned Provisional Specification there is described a cock which includes means for imparting a small initial axial movement to the plug member, during opening of the valve, so as to relieve the pressure between the plug and its seating or socket and thus facilitate opening of the cock. For certain purposes (for example in the case of a cock for controlling the steam supply to a winch) it is found that the ease with which the improved cock can be opened causes a too sudden rush of the fluid controlled by the cock and to overcome this the ports in the plug and/or valve body are, according to the present invention, arranged so as to give a relatively gradual increase in the amount of opening of the cock as the operating handle is rotated. Conveniently, this is effected by providing the plug with a diagonal row of port-openings which are brought successively into communication with the port or ports in the valve body, the greatest amount of opening being obtained when all the port-openings are open to the port or ports in the body of the cock. Preferably these port-openings are of progressively increasing diameter, the first port-opening being relatively small. This is particularly convenient in the case of a cock controlling the steam supply to a winch because the one small opening can be brought into operation so as to maintain a small supply of steam to the winch, sufficient to keep the winch warm in cold weather. In the case of a multi-way cock there may, of course, be more that one diagonal row of port-openings in the plug by which communication can be established between inlet and outlet ports in the valve body.

For other purposes a plug having only two large port-openings adapted to register respectively with inlet and outlet ports in the valve body may be satisfactory. It is convenient in such cases to make the plug in the form of a hollow body or skirt having the form of an inverted flowerpot and the port-openings may be made by cutting apertures in the walls of the plug body from the base edge thereof upwardly. This provides a certain amount of resiliency in the parts of the plug adapted to bear on the seatings and helps to ensure, due to the fluid pressure acting on said parts, a fluid-tight bearing of the plug on its seating. With this arrangement the inlet port in the cock body is preferably in alignment with the open base of the plug.

To ensure against leakage of fluid from the cock casing particularly by way of the opening through which the operating spindle passes, a labyrinthine sealing arrangement may be provided between the plug and its seating. This may be effected by turning a number of neighbouring grooves in the outer surface of the plug above the port-openings therein and, in some cases, if the port-openings do not extend to the base of the plug, also in the plug below the port-openings. The grooves may be annular or they may be spiral, in which case they must termniate short of the upper and lower ends of the plug.

Means is provided for overcoming binding or sticking between the plug and its seating immediately prior to the opening of the cock. Conveninetly said means comprises balls or rollers located in cam grooves formed in the adjacent lower end of the cock-operating shaft and the upper face of the plug, the arrangement being such that in taking up lost motion, provided by locating a compression spring between the plug and the operating shaft, the rollers or balls are moved relatively to the grooves and a very small axial movement is imparted to the plug, after which the rollers act to key the operating shaft to the plug so that continued move-

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ment of the shaft turns the plug. Preferably the faces of the grooves in the operating shaft and the upper face of the plug, which are engaged by the balls or rollers, are made of a hard material or are case-hardened so as to resist wear and prevent an undesirable increase in the amount of lost motion available to the operating shaft. Furthermore, it is desirable that the grooves for the balls or rollers, which are of eye-like form viewed from the side of the cock, should have a relatively flat curvature compared to the radius of the balls. Preferably the radius of curvature of the grooves is at least three times the radius of the balls or rollers. Alternatively, instead of making the grooves of curved form they may have the shape, in side elevation, of a very obtuse V. Whichever form is adopted it should be such that sufficient movement of the balls or rollers relatively to their grooves can take place before the balls or rollers "jam" so as to transmit the movement of the operating spindle to the plug. Preferably not more than two or three groove and roller arrangements are provided as the smaller the number of the grooves the longer they can be made so as to give the required amount of lost motion.

Preferably the plug has an upwardly extending stem which passes through the operating shaft and is provided at its upper extremity with a nut or handle screwed on to said stem. The compression spring for providing the lost motion is located under this nut or handle and by adjusting the nut or handle the amount of relative movement available to the balls or rollers in their grooves, and therefore the amount of lost motion, can be pre-set. Alternatively, the compression spring may bear on a part such as a bridge-piece secured to the cock casing, shims being located between the bridge-piece and the casing to adjust the degree of compression of the spring. The compression spring may be a spiral spring or a leaf spring tending to raise the plug and press it against its seating.

Due to the ease with which the cock can be opened it is possible to operate it from a remote station, say the bridge of a ship, by means of a light pulling wire. On large type high pressure control valves operation can be effected by the use of a hand lever of average length but for infinitely variable port-openings the use of a worm and worm-sector gear may be desirable.

Furthermore, with the cock, according to the present invention, due to the fact that the fluid pressure acts to press the plug against its seating there is less tendency of the plug to creep round when not fully opened or closed. The plug can be locked open or closed by screwing the nut or adjusting handle tight down on the spring.

A stop may be provided to limit the movement of the operating handle and an indicating means may be provided for indicating the amount of opening of the cock, particularly when the plug has a number of graduated port-openings. As an alternative to a number of graduated port-openings a port-opening in the form of an inclined slot may be provided in the plug to give a gradual increase in the flow of fluid controlled by the valve. The plug and its seating, which seating is in the form of a sleeve, are located as a unit in the cock casing, by way of a top opening which is closed by a removable cover. Adjusting shims may be located between said cover and a thrust bearing which takes the thrust on the operating spindle.

In some cases it is desirable to provide means for controlling and positioning the operating handle in any position of adjustment between that giving full opening, and that giving full closure, of the valve. In the arrangement about to be described the means for doing this is combined with the spring which draws the plug onto its seating. This spring is in the form of a plate having downwardly turned, pointed ends. The centre portion of the spring has a square hole by which the spring is fitted over a square section part of the stem on the plug, this centre portion of the spring being welded to the underside of a nut threaded on the upper part of said stem. The spring is adjusted along the stem by rotating said nut so as to provide a small clearance between the spring and the boss of the operating handle, which handle is keyed to the tubular valve operating shaft. The spring is locked in this position by a locking nut also threaded on the said stem. A plate having a circumferential row of bosses or recesses is secured to the cover of the valve casing by stop pins so that as the valve is operated, the pointed downturned ends of the springs travel over and successively engage the said bosses, at least one end of the spring always resting on the plate so as to raise the plug towards its seat. The bosses may be arranged so that the ends of the spring lie respectively one over one recess and the other between two recesses. When the valve is operated the handle and operating shaft will first move to take up the lost motion, without causing corresponding rotation of the plug and its stem. The plug will then be eased slightly relatively to its seat and against the action of the spring. Further movement of the handle will open the valve at the

same time causing the ends of the spring to snap successively over the bosses, thus retaining the valve in its position of adjustment, preventing a too rapid opening of the valve, and giving a " feel " indication of the amount by which the valve has been opend. The handle engages the stop pins at the full open and closed positions.

The cam devices for providing the initial easing of the plug may comprise washers having facing, oppositely inclined, recesses for the balls or rollers, and fitted over the plug stem and in an annular recess in the top of the plug. These recesses also taper towards each other in a direction towards the stem axis so as to retain the balls or rollers at a constant radial distance from said stem. The rollers will be correspondingly tapered.

Dated this 22nd day of April, 1943.
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PROVISIONAL SPECIFICATION
No. 16172 A.D. 1943.

Improvements in or relating to Valves and Cocks

I, CHARLES GUTHRIE GUTHRIE, a British Subject, of " Altair ", Formby, in the County of Lancaster, do hereby declare the nature of this invention to be as follows:—

This invention is for improvements in or relating to valves and cocks. The invention is concerned with cocks of the plug type, i.e. of the type comprising a valve casing, having inlet and outlet ports, and a plug, which is generally tapered, rotatable in a seating or tapered socket in the valve casing and having a through passage or port which, when the valve is open, connects the inlet and outlet ports of the casing.

Cocks of the above mentioned type often give trouble due to excessive friction and binding between the plug and its socket or seating so that it is very difficult to open the valve. This is particularly the case with steam or like cocks where the plug may be subjected to considerable pressure acting to force it against the walls of the socket. One object of the present invention is to overcome this difficulty.

According to the present invention there is provided a valve of the type above set forth, wherein the valve-operating means when operated to open the valve is adapted to impart a small initial axial movement to the plug prior to, or simultaneously with, the normal angular movement, so as to relieve the pressure between the plug and its socket or seating. Conveniently the axial movement is imparted to the plug by cam devices located between the lower end of a valve-operating shaft and the upper end of the plug. These cam devices may comprise balls or rollers (preferably tapered rollers) located in cam grooves formed in the adjacent lower end of the operating shaft and the upper face of the plug and arranged so that in taking up lost motion between the plug and its operating shaft, the rollers are moved relatively to the grooves in the plug and a small axial movement to relieve the pressure is given to the plug, after which the rollers act, somewhat after the manner of a free wheel, to provide a coupling between the plug and the operating shaft. Preferably a thrust bearing is provided between the plug, or its operating shaft, and the casing to take the upward thrust on the plug. Conveniently the operating shaft is spring-loaded into engagement with the plug so as to provide the required lost motion for giving the axial movement.

One embodiment of the invention as applied to a two-way steam cock will now be described by way of example.

The cock comprises a valve casing having a flanged steam inlet port at its lower part and a flanged outlet port at one side. A removable brass valve seating or socket part is fitted in the body of the casing through an opening in the upper part thereof, jointing material being located between the seating and the casing to provide a steam-tight joint. The seating has ports which register with the ports in the casing. A tapered plug is fitted into the seating which is tapered to correspond with the plug, the plug tapering from the bottom upwards and having a short cylindrical section at its upper part which makes a fluid-tight joint with steam packing located in a stuffing box formed between the upper part of the removable seating and the valve cover. It will be noted that in this particular example the tapered plug is inverted as compared with the usual arrangement in valves of this type and the plug is located in the seating before the latter is fitted in the casing. The plug has an upwardly extending stem part over which is fitted a tubular operating shaft which terminates

at its lower part in a collar spaced a short distance above the upper face of the plug. Two, three, four or more radial part-cylindrical cam grooves are formed in the said upper face of the plug and corresponding grooves are formed in the adjacent face of the collar, and tapered rollers are located in the chambers formed by the co-operating grooves. The collar on the shaft is adjusted relatively to the plug, so as to leave a clearance therebetween, by a nut threaded into the valve cover and bearing on the collar of the shaft through a ball thrust bearing. The upper part of the operating shaft is of square section and a handle is fitted over this part for operating the cock. The handle is held in position by nuts threaded on the end of the stem part of the plug and a spring washer is interposed between the handle and the nuts so as to prevent the plug being tightened solid to the collar on the operating shaft.

To open the cock the handle is moved angularly and the angular motion imparted to the operating shaft causes the rollers to move relatively to the cam grooves in the plug and the plug is forced slightly forwardly within the limits permitted by the spring washer, after which the rollers key the shaft to the plug and the plug can be turned easily to the open position.

A stop may be provided on the bottom of the casing around the inlet port for limiting the downward axial movement of the plug.

For certain purposes (for example in the case of a cock controlling the steam supply to a winch) it is found that the ease with which the improved cock can be opened causes a too sudden rush of the fluid controlled by the cock and to overcome this the ports in the plug and/or valve body may be arranged so as to give a relatively gradual increase in the amount of opening of the cock as the operating handle is rotated. Conveniently, this is effected by providing the plug with a diagonal row of port-openings which are brought successively into communication with the port or ports in the valve body, the greatest amount of opening being obtained when all the port-openings are open to the port or ports in the body of the cock. Preferably those port-openings are of progressively increasing diameter, the first port-openings being relatively small. This is particularly convenient in the case of a cock controlling the steam supply to a winch because the one small opening can be brought into operation so as to maintain a small supply of steam to the winch, sufficient to keep the winch warm in cold weather. In the case of a multi-way cock there may, of course, be more than one diagonal row of port-openings in the plug by which communication can be established between inlet and outlet ports in the valve body.

For other purposes a plug having only two large port-openings, which are preferably trapezoidal, adapted to register respectively with inlet and outlet ports, which are also preferably trapezoidal, in the valve body may be satisfactory. It is convenient in such cases to make the plug in the form of a hollow body or skirt having the form of an inverted flower pot and the port-openings may be made by cutting apertures in the walls of the plug body from the base edge thereof upwardly. This provides a certain amount of resiliency in the parts of the plug adapted to bear on the seatings and helps to ensure, due to the fluid pressure acting on said parts, a fluid-tight bearing of the plug on its seating. With this arrangement the inlet port in the cock body is preferably in alignment with the open base of the plug. By making the base of the plug open the fluid pressure has little effect towards forcing the plug away from its seating.

To ensure against leakage of fluid from the cock casing particularly by way of the opening through which the operating spindle passes, a labyrinthine sealing arrangement may be provided between the plug and its seating. This may be effected by turning a number of neighbouring grooves in the outer surface of the tapered plug above the port-openings therein and, in some cases, if the port-openings do not extend to the base of the plug, also in the plug below the port-openings do not extend to the base of the plug, also in the plug below the port-openings. The grooves may be annular or they may be spiral, in which case they must terminate short of the upper and lower ends of the plug.

Preferably the faces of the cam grooves in the operating shaft and in the upper face of the plug, which are engaged by the balls or rollers, are made of a hard material or are case-hardened so as to resist wear and prevent an undesirable increase in the amount of lost motion available to the operating shaft. Furthermore, it is desirable that the cam grooves for the balls or rollers, which are of eye-like form viewed from the side of the cock, should have a relatively flat curvature compared to the radius of the balls. Preferably the radius of curvature of the grooves is at least three times the radius of the balls or rollers. Alternatively, instead of making the grooves of curved form they may have the shape, in side

elevation, of a very obtuse V. Whichever form is adopted it should be such that sufficient movement of the balls or rollers relatively to their grooves can take place before the balls or rollers "jam" so as to transmit the movement of the operating spindle to the plug. Preferably not more than two or three groove and roller arrangements are provided as the smaller the number of the grooves the longer they can be made so as to give the required amount of lost motion.

Preferably, as stated, the plug has an upwardly extending stem which passes through the operating shaft and is provided at its upper extremity with a nut or clamp screwed on to said stem. The compression spring for providing the lost motion is located under this nut or clamp and by adjusting the nut or clamp the amount of relative movement available to the balls or rollers in their cam grooves, and therefore the amount of lost motion, can be pre-set. Alternatively, the compression spring may bear on a part such as a bridge-piece secured to the cock casing, shims being located between the bridge-piece and the casing to adjust the degree of compression of the spring. The compression spring may be a spiral spring or a leaf spring tending to raise the plug and press it against its seating.

Due to the ease with which the cock can be opened it is possible to operate it from a remote station, say the bridge of a ship, by means of a light pulling wire. On large type high pressure control valves operation can be effected by the use of a hand lever of average length but for infinitely variable port-openings the use of a worm and worm-sector gear may be desirable.

In the arrangement where the fluid pressure acts to press the plug against its seating there is less tendency of the plug to creep round when not fully opened or closed. The plug can be locked open or closed by screwing the nut or clamp tight down on the spring.

A stop may be provided to limit the movement of the operating handle and an indicating means may be provided for indicating the amount of opening of the cock, particularly when the plug has a number of graduated port-openings. As an alternative to a number of graduated port-openings a port-opening, or two oppositely disposed port-openings, in the form of an inclined slot or aperture having an inclined edge (e.g. an aperture of trapezoidal form) may be provided in the plug and seating to give a gradual increase in the flow of fluid controlled by the valve. In the case of a trapezoidal aperture that in the plug would be of opposite hand to that in the seating. The plug and its seating are located as a unit in the cock casing, by way of a top opening which is closed by a removable cover. Adjusting shims may be located between said cover and a thrust bearing which takes the thrust on the operating spindle.

In some cases it is desirable to provide means for controlling and positioning the operating handle in any position of adjustment between that giving full opening, and that giving full closure, of the valve. In the arrangement about to be described the means for doing this is combined with the spring which draws the plug onto its seating. This spring is in the form of a plate having downwardly turned, pointed ends. The centre portion of the spring has a square hole by which the spring is fitted over a square section part of the stem on the plug, this centre portion of the spring being welded to the underside of a nut threaded on the upper part of said stem. The spring is adjusted along the stem by rotating said nut so as to provide a small clearance between the spring and the boss of the operating handle, which handle is keyed to the tubular valve operating shaft. The spring is locked in this position by a locking nut also threaded on the said stem. A plate having a circumferential row of bosses or recesses is secured to the cover of the valve casing by stop pins so that as the valve is operated, the pointed downturned ends of the spring travel over and successively engage the said bosses, at least one end of the spring always resting on the plate so as to raise the plug towards its seat. The bosses may be arranged so that the ends of the spring lie respectively one over one recess and the other between two recesses. When the valve is operated the handle and operating shaft will first move to take up the lost motion, without causing corresponding rotation of the plug and its stem. The plug will then be eased slightly relatively to its seat and against the action of the spring. Further movement of the handle will open the valve at the same time causing the ends of the spring to snap successively over the bosses, thus retaining the valve in its position of adjustment, preventing a too rapid opening of the valve, and giving a "feel" indication of the amount by which the valve has been opened. The handle engages the stop pins at the full open and closed positions.

In an alternative arrangement for controlling the movement of the handle the cover of the valve casing has a hollow boss which receives the boss of the handle which is in the form of a lever. Part of the circumferential wall of said hollow boss is cut away to accommodate the boss of the handle and permit movement

thereof, the movement of the handle being limited by engagement with the sides of the cut-away part of the hollow boss. The part of the circumferential wall of the hollow boss opposite the cut-away part thereof is enlarged and bored to form a chamber which houses a spring and a detent or plunger, the spring being secured in the chamber by a screw so that it urges the detent towards the axis of the valve. The boss of the handle has part of its periphery formed with vertical, spaced, notches after the manner of the teeth on a spur gear wheel and when the boss of the handle is fitted in the said hollow boss the detent engages in one of said notches. As the handle is moved angularly to operate the valve the detent snaps from one notch to the next.

The cam portion of the tapered plug may be in the form of a separate ring which is let into a deep circumferential recess in the top of the plug and is secured against rotation therein by dowel pins. This recess also houses the cam part of the tubular operating shaft.

The valve seating which, as stated, is preferably in the form of a bush may be secured in position by dowel pins which engage in holes in the cover of the valve casing.

The cam grooves in the plugs and shaft may also taper towards each other in a direction towards the stem axis so as to retain the balls or rollers at a constant radial distance from said stem. The rollers will be correspondingly tapered.

Dated this 1st day of October, 1943.

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COMPLETE SPECIFICATION

Improvements in or relating to Valves and Cocks

I, CHARLES GUTHRIE GUTHRIE, a British Subject, of "Altair", Formby, in the County of Lancaster, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to valves and cocks. The invention is concerned with cocks of the plug kind, i.e. of the kind comprising a valve casing, having inlet and outlet ports, a tapered plug rotatable in a seating or tapered socket located in the valve casing and having a passage or port which, when the valve is open, connects the inlet and outlet ports of the casing and means, operable during the initial movement of the valve-operating member in the opening direction, to ease the plug off its seating and facilitate movement thereof in the opening direction, the plug being inserted into the casing so that the fluid pressure at the inlet acts to force the plug onto its seating.

According to the present invention there is provided a cock of the kind specified wherein the casing has an inlet port opposite the wide end of the tapered plug so that fluid pressure at said inlet acts to force the plug onto its seating and wherein means, actuated by the initial movement of the valve-operating member in the opening direction, is provided for applying a force to the narrow end of the plug tending to force the plug off its seating, and wherein the plug is inserted wide end foremost into the cock casing and said casing has a ported plug-socket or seating, tapered to receive the plug and which is a substantially fluid tight fit in a cavity in the casing, the ports in said socket registering with the ports in the casing.

The purpose of this combination is to utilise the fluid pressure to provide a good fluid-tight seal between the plug and its seating and at the same time ensure an easy opening of the cock by providing means to counteract this fluid pressure automatically when action is taken to open the cock by turning the plug, the seating enabling the plug, which has an operating stem extending from its narrow end, to be inserted wide end foremost in the casing.

Preferably axial movement is imparted to the plug, to counteract the pressure of the fluid at the inlet, by cam devices located between the lower end of a valve-operating shaft and the upper end of the plug. These cam devices may comprise balls or rollers (preferably tapered rollers) located in cam grooves formed in the adjacent lower end of the operating shaft and the upper face of the plug and arranged so that in taking up lost motion between the plug and its operating shaft, the rollers are moved relatively to the grooves in the plug and a small axial movement to relieve the pressure is given to the plug, after which the rollers act, somewhat after the manner of a free wheel, to provide a coupling between the plug and the operating shaft. Preferably a thrust bearing is provided between the plug operating shaft and the casing to

take the upward thrust on the plug. Conveniently the operating shaft is spring-loaded into engagement with the plug so as to provide the required lost motion for giving the axial movement.

One embodiment of the invention as applied to a steam cock will now be described by way of example, with reference to the accompanying drawing. On the drawing:—

Figure 1 is a sectional side elevation of the cock,

Figure 2 is an end elevation, the left-hand half of the Figure being in section,

Figure 3 is a plan view partly in section,

Figure 4 is an exaggerated diagram illustrating the manner of operation of the valve shown in Figures 1, 2 and 3, and

Figure 5 is a semi-diagrammatic view of a modified form of plug and socket for the valve shown in Figures 1, 2 and 3.

The cock comprises a valve casing 10 having a flanged inlet port 11 at its lower part and flanged outlet ports 12 at opposite sides. A removable brass plug seating or socket part 13 is fitted in the body of the casing through an opening 14 in the upper part thereof. Jointing material may be located between the socket 13 and the casing to provide a steam-tight joint, but in the arrangement shown it is proposed to provide a fluid-tight seal by "grinding in" the faces 15 and 16. The "grinding in" operation may be effected by applying grinding paste to the faces 15 and 16 and oscillating the seating angularly by means of the locating pins 17. The socket 13 has ports 18 which register with the ports 12 in the casing. A tapered plug 19 is fitted into the socket 13 which is tapered to correspond with the plug, the plug tapering from the bottom upwards. The plug is hollow and has ports 19*a*. It will be noted that the tapered plug is inverted as compared with the usual arrangement in valves of this type. The plug 19 is located in the socket 13 before the latter is finally fitted in the casing, and this greatly facilitates assembly of the valve and eliminates the necessity of providing special facilitites on the casing for the insertion of the plug which is larger than the ports in the casing. The plug has an upwardly extending stem part 20 over which is fitted a tubular operating shaft 21 which terminates at its lower part in a collar 22 spaced a short distance above the upper face 23 of the plug 19. Two, three, four or more radial part-cylindrical cam grooves 24 are formed in an upper part of the plug and corresponding grooves 25 are formed in the adjacent face of the shaft 21. Tapered rollers 26 are located in the chambers formed by the co-operating grooves. The upper part 27 of the operating shaft is of square section and a handle 28 is fitted over this part for operating the cock. The handle is held in position by a nut 29 threaded on the end of the stem part 20 of the plug and a spring washer 30 is interposed between the handle and the nut. The cover 31 of the cock is secured to the casing 10 by screws 32, the locating pins 17 locating the seating 13 correctly with respect to the ports 12 in the casing. Up-thrust of the shaft 21 is taken by a ball or roller thrust bearing 33 housed in the cover.

To open the cock the handle 28 is moved angularly and the angular motion imparted to the operating shaft 21 causes the rollers 26 to move relatively to the cam grooves 24 and 25 and the plug 19 is forced slightly downwardly, this movement being permitted by the spring washer 30, after which the rollers 26 key the shaft 21 to the plug and the plug can be turned easily to the open position. This is shown clearly in Figure 4, the "eased" position of the plug being represented by the dotted lines.

A stop 34 may be provided on the bottom of the casing around the inlet port for limiting the downward axial movement of the plug.

For certain purposes (for example in the case of a cock controlling the steam supply to a winch) it is found that the ease with which the improved cock can be opened may cause a too sudden rush of the fluid controlled by the cock and to overcome this the ports in the plug and/or valve body may be arranged so as to give a relatively gradual increase in the amount of opening of the cock as the operating handle is rotated. Conveniently, this is effected by providing the plug with a diagonal row of port-openings 19*b* (as shown in Figure 5) which are brought successively into communication with the port or ports 18 in the valve seating 13. The port-openings 19*b* are of progressively increasing diameter as shown, the first port-openings being relatively small. This is particularly convenient in the case of a cock controlling the steam supply to a winch because the one small opening can be brought into operation so as to maintain a small supply of steam to the winch, sufficient to keep the winch warm in cold weather. In the case of a multi-way cock there may, of course, be more than one diagonal row of port-openings in the plug by which communication can be established between inlet and outlet ports in the valve body.

For other purposes a plug having one or more large port-openings 19*a*, which

are preferably trapezoidal, as shown in Figure 2, adapted to register with inlet ports 18, which are also preferably trapezoidal, may be satisfactory. It may be convenient in such cases to make the plug in the form of a hollow body or skirt having the form of an inverted flower pot, the port-openings being made by cutting apertures in the walls of the plug body from the base edge thereof upwardly. This provides a certain amount of resiliency in the parts of the plug adapted to bear on the seating and helps to ensure, due to the fluid pressure acting on said parts, a fluid-tight bearing of the plug on its seating. The inlet port 11 in the cock body is in alignment with the open base of the plug as shown in Figures 1 and 2. By making the base of the plug open the fluid pressure acts to force the plug onto its seating 13.

To ensure against leakage of fluid from the cock casing particularly by way of the opening through which the operating spindle passes, a labyrinthine sealing arrangement may be provided between the plug and its seating. This may be effected by turning a number of neighbouring grooves 35 in the outer surface of the plug (which may be truly cylindrical at its upper part) above the port-openings therein and, in some cases, if the port-openings do not extend to the base of the plug, also in the plug below the port-openings as indicated at 36 in Figure 1. The grooves 35 and 36 may be annular or they may be spiral, in which case they must terminate short of the upper and lower ends of the plug.

Preferably the faces of the cam grooves 24 and 25 in the operating shaft and in the upper face of the plug, are made of a hard material or are case-hardened so as to resist wear and prevent an undesirable increase in the amount of lost motion available to the operating shaft. Furthermore, it is desirable that the cam grooves for the balls or rollers, which are of eye-like form viewed from the side of the cock, should have a relatively flat curvature compared to the radius of the balls. Preferably the radius of curvature of the grooves 24 and 25 is at least three times the radius of the balls or rollers 26. Alternatively, instead of making the grooves of curved form they may have the shape, in side elevation, of a very obtuse V. Whichever form is adopted it should be such that sufficient movement of the balls or rollers relatively to their grooves can take place before the balls or rollers "jam" so as to transmit the movement of the operating spindle to the plug so as to cause angular movement thereof. Preferably not more than two or three groove and roller arrangements are provided as the smaller the number of the grooves the longer they can be made so as to give the required amount of lost motion.

By adjusting the nut 29 the amount of relative movement available to the balls or rollers in their cam grooves, and therefore the amount of lost motion, can be pre-set. Alternatively, the compression spring 30 may bear on a part such as a bridge-piece secured to the cock casing or cover 31, shims being located between the bridge-piece and the casing or cover to adjust the degree of compression of the spring. The compression spring 30 may be a helical spring as shown or a leaf spring tending to raise the plug and press it against its seating.

Due to the ease with which the cock can be opened it is possible to operate it from a remote station, say the bridge of a ship, by means of a light pulling wire. On large type high pressure control valves operation can be effected by the use of a hand lever of average length but for infinitely variable port-openings the use of a worm and worm-sector gear may be desirable.

Due to the fact that the fluid pressure acts to press the plug against its seating there is little, if any, tendency of the plug to creep round when not fully opened or closed. The plug can be locked open or closed by screwing the nut 29 tight down on the spring 30.

A stop may be provided to limit the movement of the operating handle and an indicating means may be provided for indicating the amount of opening of the cock, particularly when the plug has a number of graduated port-openings. As an alternative to a number of graduated port-openings a port-opening in the form of an inclined slot may be provided in the plug 19 and seating 13 to give a gradual increase in the flow of fluid controlled by the valve. In the case of a trapezoidal aperture as shown in Figure 2 that in the plug would be of opposite hand to that in the seating. The plug and its seating are located as a unit in the cock casing, by way of the top opening which is closed by the removable cover 31. Adjusting shims may be located between said cover and the thrust bearing 33. It will be noted that a clearance 37 is provided between the casing and its cover 31 so that no special machining of the neighbouring faces of those two parts is necessary, the fluid-tight joints being made at the surfaces 15 and 16.

In some cases it is desirable to provide means for controlling and positioning the operating handle in any position of adjustment between that giving full opening,

and that giving full closure, of the valve. For this purpose, in the arrangement shown in Figures 1, 2 and 3, the cover 31 of the valve casing has a hollow boss 38 which receives the boss 39 of the handle 28. Part of the circumferential wall of said hollow boss 38 is cut away at 40 to accommodate the handle and permit movement thereof, the movement of the handle being limited by engagement with the sides 41 of the cut-away part of the hollow boss. The part of the circumferential wall of the hollow boss opposite the cut-away part thereof is enlarged and bored to form a chamber 42 which houses a spring 43 and a detent or plunger 44, the spring being secured in the chamber by a screw 45 so that it urges the detent towards the axis of the valve. The boss of the handle has part of its periphery formed with vertical, spaced, notches 46 (see Figure 3) after the manner of the teeth on a spur gear wheel and when the boss of the handle is fitted in the said hollow boss the detent engages in one of said notches. As the handle is moved angularly to operate the valve the detent snaps from one notch to the next.

The cam-face part 24 of the tapered plug may be in the form of a separate ring which is let into a deep circumferential recess in the top of the plug and is secured against rotation therein by dowel pins as shown in Figure 1. This recess also houses the cam-face part of the tubular operating shaft.

The cam grooves in the plug and shaft may conveniently taper towards each other in a direction towards the axis of the stem 20 so as to retain the balls or rollers at a constant radial distance from said stem. The rollers will be correspondingly tapered.

The plug and its socket (and in some cases the casing also) may be made of glass, preferably one of the heat-resisting glasses such as that sold under the Registered Trade Mark "Pyrex", or plastic. A cock having a glass plug and socket would be of particular value in the handling of chemicals and corrosive fluids. The separate socket and the pressure relieving features of the cock, according to the present invention, make it particularly suitable for construction, at least so far as the plug and its socket are concerned, from glass or plastic.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A cock of the kind specified wherein the casing has an inlet port opposite the wide end of the tapered plug so that fluid pressure at said inlet acts to force the plug onto its seating and wherein means, actuated by the initial movement of the valve-operating member in the opening direction, is provided for applying a force to the narrow end of the plug tending to force the plug off its seating and wherein the plug is inserted wide end foremost into the cock casing and said casing has a ported plug-socket or seating, tapered to receive the plug, and which is a substantially fluid-tight fit in a cavity in the casing, the ports in said socket registering with the ports in the casing.

2. A cock as claimed in claim 1, wherein the plug has a stem or extension extending from its smaller end and through an aperture in the casing and wherein the casing has a plug-socket which, with the plug in position in it, is located as a substantially fluid-tight fit in a cavity in the casing via said aperture.

3. A cock as claimed in either of the preceding claims and comprising a plug having a stem extending from its smaller end and through an aperture in the casing, a cock-operating shaft rotatably supported on said stem, spring means between said cock-operating shaft and the stem to permit limited axial movement of the plug relatively to said operating shaft, and cam means between the shaft and the plug arranged so that initial angular movement of the shaft to rotate the plug causes limited axial movement of the plug to relieve the bond between said plug and its socket.

4. A cock as claimed in any of the preceding claims, wherein the plug socket is located and held in position in the casing by the cover thereof.

5. A cock as claimed in claim 3, wherein the cam means comprises one or more cam grooves in the neighbouring faces of the shaft and plug and a ball or roller in each pair of co-operating cam grooves operatively connecting the shaft to the plug so that angular movement of the plug first, through the balls or rollers, causes slight axial movement of the plug and then angular movement thereof to open or close the cock.

6. A cock as claimed in any of the preceding claims 3 to 5, wherein the operating shaft has a collar which bears against a thrust bearing which prevents axial movement of the shaft relatively to the plug and takes the thrust due to the cam means.

7. A cock as claimed in claim 5 or claim 6, wherein the plug or the operating shaft, or both, have readily removable cam surface parts.

8. A cock as claimed in any of the preceding claims, wherein the plug is

hollow and is in the form of a skirt and wherein the fluid inlet of the cock is arranged so that the fluid pressure acts on the resilient walls of the skirt to press the plug against its socket and maintain a fluid-tight joint.

9. A cock as claimed in any of the preceding claims, wherein the plug or its socket or both have a series of ports adapted to be opened step-by-step by angular movement of the plug.

10. A cock as claimed in claim 9, wherein the ports in said series are of varying size.

11. A cock as claimed in any of the preceding claims, wherein the plug or its socket or both are grooved circumferentially, at their engaging surfaces, to provide a labyrinthine fluid-tight sealing arrangement.

12. A cock as claimed in any of the preceding claims, wherein the plug-socket has a collar or collars which make fluid-tight joint with shoulders in the casing and wherein the plug-socket is rotatable for the purpose of "grinding in" the abutting faces of each collar and shoulder.

13. A cock as claimed in any of the preceding claims and further comprising a spring-loaded detent adapted to engage successively one of a series of notches in, or in a part connected to, the operating member of the cock so as to control the movement of said member.

14. A cock as claimed in any of the preceding claims, wherein the plug-socket is made of glass or plastic.

15. A cock substantially as described with reference to Figures 1, 2, 3 and 4 or as modified according to Figure 5 of the accompanying drawings.

Dated this 22nd day of April, 1944.

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Water Street, Liverpool, 3.

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FIG. 1.

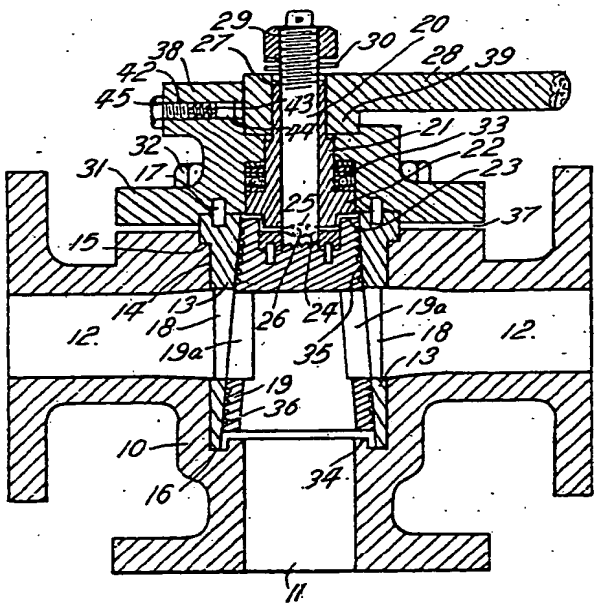

FIG. 2.

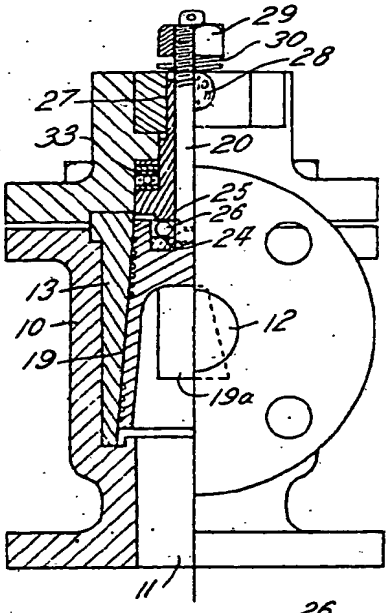

FIG. 3.

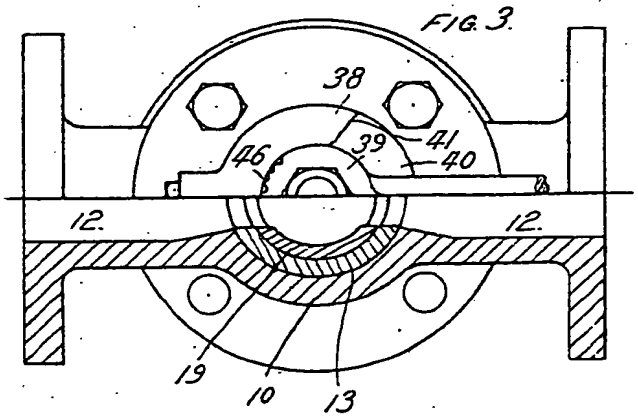

FIG. 4

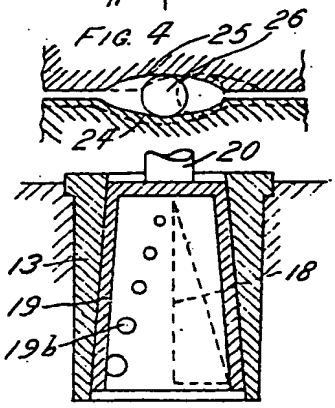

FIG 5

Malby & Sons, Photo-Lith.